SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor of Engineering (HONS.) in Mechatronics Engineering.

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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DEVELOPMENT OF ROBOT KIT FOR VISUALLY IMPAIRED

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ABSTRAK

Masalah penglihatan adalah kehilangan keupayaan untuk melihat sama ada secara beransur-ansur atau buta. Orang yang mengalami keadaan ini akan menderita dengan banyak kesulitan dalam hidupan seharian. Mereka tidak boleh mengerak seperti orang biasa kerana maklumat visual mereka adalah terhad berbanding dengan orang biasa. Oleh itu, robot panduan yang boleh membimbing orang yang cacat penglihatan daripada haling atau dinding boleh menolong mereka berjalan seperti orang biasa. Robot panduan ini dilengkapi dengan tiga sensor ultrasonic yang berfungsi sebagai "mata" orang cacat penglihatan. Sensor-sensor ini akan mengumpul jarak di kawasan depan robot dan membuat keputusan untuk mengubah kelajuan setiap motor robot. Untuk menguji fungsi robot panduan ini, ia diuji dalam tiga situasi yang berbeza and setiap situasi akan diuji sepuluh kali. Daripada eksperimen tersebut, didapati kadar kejayan keseluruhan adalah sekitar 83.33 peratus. Selain daripada itu, percubaan untuk membina struktur badan robot juga mendapat keputusan yang memuaskan. Reka bentuk badan robot berjaya dibina keluar.

ABSTRACT

Visual impairment is the loss of the ability to see either gradually or totally lost sight, this situation also call blind. People who suffer with this lost are called visually impaired. They are experienced many inconvenience and one of them is their mobility is totally affected where they cannot travel like ordinary people because their visual information is less compare with other. Therefore, a guidance robot which can guide the visually impaired away from obstacle and wall is required. With this avoidance, visually impaired can less concern about their defective vision because they can follow the guidance path of the robot. The robot is equipped with three ultrasonic sensors which is function as the "eyes" of visually impaired for gather the distance information in an area in front them. All the distance information is used as condition to alter the ratio of pulse width modulation applied to each motor of the robot. Thus, the speed of the wheels is based on the condition of environment. To test the functionality of the obstacle avoidance algorithm, the guidance robot is tested in three different situations. The overall success rate is around 83.33 percent. Apart from these, biomaterial is attempted to use to construct the body structure of the robot where the shape of the robot's body structure is successfully fabricated out.

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LIST OF SYMBOLS

t	Time
c	Velocity of sound
D_R	Moving distance between robot's previous and current position
D_{obs}	Moving distance of moving obstacle
X_{R1}	Initial x-axis position of mobile robot
X_{R2}	Final x-axis position of mobile robot
Y_{R1}	Initial y-axis position of mobile robot
Y_{R2}	Final y-axis position of mobile robot
X_{obs1}	Initial x-axis position of moving obstacle
X_{obs2}	Final x-axis position of moving obstacle
Y_{obs1}	Initial y-axis position of moving obstacle
Y_{obs2}	Final y-axis position of moving obstacle
a_1	Count of detected obstacle
θ_2	New possible steering direction
X_0	X-axis position of destination
X_m	X-axis position of mobile robot
Y_0	Y-axis position of destination
Y_m	Y-axis position of mobile robot
F_r	Repulsive force
F_a	Attractive force
D_{ro}	Obstacle distance from robot
D_{rg}	Robot and goal distance
n	Positive optimization parameters
p	Positive optimization parameters
F_e	Escape force
$d_{diagonal}$	Diagonal distance between robot and obstacle
d_{front}	Front distance between robot and obstacle
v_{wheel}	Robot's wheel speed
v_{max}	Maximum optimum speed for the guidance robot
d_1	Distance 1
d_2	Distance 2

t_{turn}	Turning time
V	Volts

LIST OF ABBREVIATIONS

GPS	Global Position System
GIS	Geographic Information System
LRF	Laser Range Finder
cm	Centimeter
m	Meter
m/s	Meter per second
HFA	Hybrid Fuzzy Algorithm
VFH	Vector Field Histogram
APF	Artificial Potential Field
PWM	Pulse Width Modulation

CHAPTER 1

INTRODUCTION

1.1 Project background

Mobility canes, which is a type of mobility assist for people who are having vision impairment. Regarding to the needs of them, Orientation and Mobility Specialist will decide the cane types they will use. Generally, they are using white cane or guidance dog to assist them walking but guidance dog is less preferred because of the high maintenance fees to take care the dog (Sung et al., 2001). In the past few decades, robotic device has been developed rapidly to assist physically disabled people, from simple prosthetic limbs to mind control prosthetic which is a remarkable breakthrough credit to robotic and neurosciences research achievement (Lavars, 2016). Therefore, instead of using old style mobility canes to assist the visually impaired people, improvement of these mobility canes should be done to increase the efficiency and effectiveness of their mobility assist ability.

Few methods address to this problem have been published and they are mainly separated into indoor and outdoor environments navigation by sonar, Global Positioning System (GPS), camera, Geographic Information System (GIS), and Laser Range Finder (LRF) (Genci et al., 2011). In this paper, a robot kit development is proposed to assist the visually impaired people for their mobility with an additional feature of using biomaterial to build the robot body.

1.2 Problem statement

Visually challenged people are always faced situation when walking, they cannot walk confidently because they cannot get the environment information in form of sighting like we all do. Although there are already many devices that has the same function, the product is normally non-affordable for a low to moderate income needy. Furthermore,

the usage of plastic as the robot's body material, it will pollute the environment or hazard the user if the steel used is rusting because of coating drop off due to knocking.

1.3 Objective

The objectives of this project are as follow:

1. To develop a robot device that assist mobility of visually impaired by avoiding obstacles with affordable cost.
2. To develop an algorithm for obstacles avoidance that keep the robot from hitting walls or obstacle.

1.4 Significant of project

In year 2014, estimated there are 285 million of people visually impaired. Mainly of them, 246 million having low vision and 39 million is blind (World Health Organization, 2014). Hence, a robot device is researched by applying least information received and guide the visually impaired people to enhance their mobility, or in other words the robot will guide them to avoid from obstacles and walls to prevent them hitting on them. Besides, attempt in using biomaterial for constructing the device as consider to sensitive skin type. Moreover, biomaterial is degradable and environmental green, it will not increase the wastes on this planet.

1.5 Scope of project

This project is aimed to operate in indoor environments like inside house, walking corridor, and lab. Moreover, the research is also avoided to test on a crowded space. Staircase and step are also excluded from the research scope.

On design perspective, only ultrasonic sensor or sonar is applied as a distance measure or obstacle detector. Therefore, acoustic properties materials or structures obstacles are neglected from the research since the ultrasonic will be absorbed by them. On the other hand, the ultrasonic sensor deployed cannot sense obstacle or wall which is not perpendicular to it. Hence, it may ignore some of the obstacle or wall that around it due to the sound wave emitted by the sensor is reflected away.

1.6 Thesis outline

Chapter 1: Introduction

Chapter 2: Literature Review

Chapter 3: Methodology

Chapter 4: Results and Discussion

Chapter 5: Conclusion and Recommendations

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